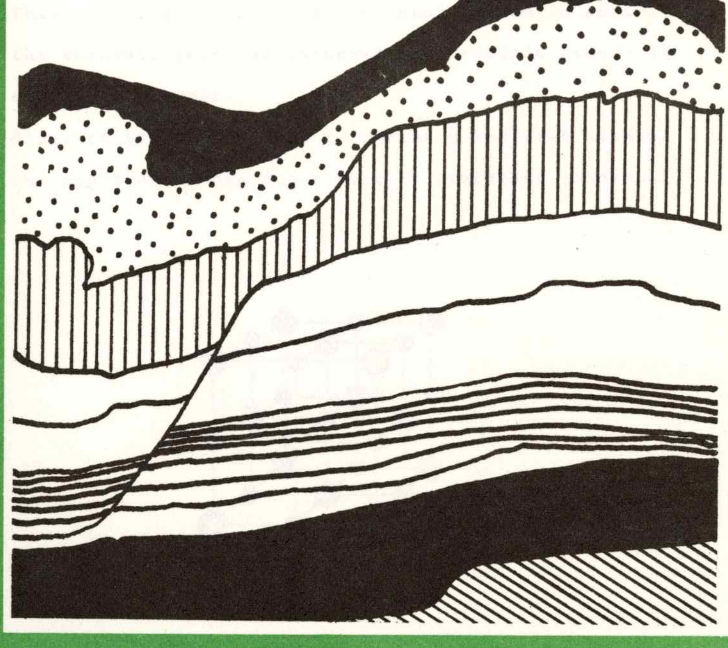
Arts and Science

Geology

Concordia University Loyola Campus

Faculty of Arts and Science

concordia
university



concordia university

DEPARTMENT OF GEOLOGY

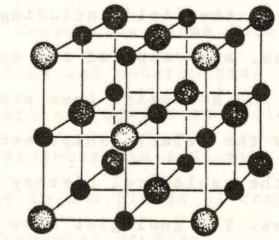
LOYOLA CAMPUS

COURSE GUIDE

1976-1977

This course guide has been prepared months in advance of the academic year and information contained herein is subject to change.

Students are advised not to purchase any text without the approval of the department or professor concerned.



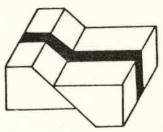
WHAT IS GEOLOGY?

Geology is the study of our planet. Although exploration of the Moon, Mars and other celestial bodies is most fascinating and adds glamour to this science, the geologist is still primarily interested in our planet and its resources. Much remains to be learned about the earth, its history, composition, structure, as well as the forces acting on it. Earthquakes, volcanic eruptions, landslides, floods and erosion constantly affect and plague man's environment. As the geologist studies these processes he helps to control his habitat. He also seeks for raw materials and new sources of energy which our complex society demands in ever increasing quantities. Geology therefore plays an important role in the progress of man and his future welfare on this planet.

WHAT DOES A GEOLOGIST DO?

The natural working place of the geologist is out in the open. Field work may consist of reconnaissance work of regions that have not yet been completely studied geologically. Many geologists work near mining camps and oil fields, carrying out detail surveys. The information gathered in the field including notes, sketches, diagrams, maps and samples, are compiled and analyzed more carefully in the laboratory. The geologist then prepares reports, maps and sections to show the relationships between the various rock types to determine the geological history of the area and its economic possibilities. The geologist also makes decisions as to where exploration efforts and money should be directed and concentrated.

Normal fault
dip-slip movement

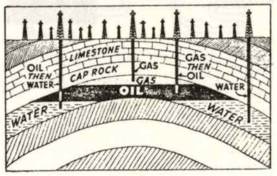


HOW DOES ONE BECOME A GEOLOGIST?

The student planning to take geology should follow the pre-Science profile while studying at the collegial level. After entering the university, the candidate will likely take, along with his courses in geology, more courses in related disciplines. Computer Science and Statistics are becoming very useful in many branches of geology. The student should also do some field work as part of his training. During the summer months, he may do field work with the Federal or Provincial surveys or with exploration and mining companies. Work on geochemical or geophysical surveys or in mines and oil fields also provides excellent experience to complement his university education.

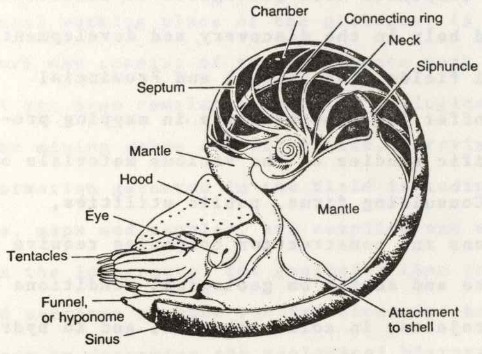
GEOLOGY AS A CAREER

Interesting careers are open to both male and female geologists. Many mining and oil companies hire geologists to undertake exploration work and help in the discovery and development of mining areas and oil fields. The Federal and Provincial Geological Surveys offer job opportunities in mapping programmes and in specific studies of the various materials of the earth's crust. Consulting firms, public utilities, financial institutions and construction companies require the geologist to evaluate and advise on geological conditions in civil engineering projects, in soil mechanics, and in hydrology. Openings also exist in the fields of consulting, teaching, research and environmental studies.



GEOLOGY AND RELATED DISCIPLINES

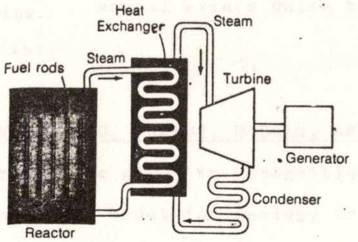
Because the field of geology is so comprehensive, it is related to many disciplines in the natural and physical sciences. Physics, chemistry, biology, mathematics, engineering and geography are some of the fields closely connected to geology. Other fields such as astronomy, oceanography, hydrology, environmental sciences, soils science, material science, metallurgy, conservation, surveying and forestry are also related to geology. Interdisciplinary programmes can be designed to suit the specific aims of particular students. For instance, a specialization programme in geology may be coupled with a minor programme in ecology or a specialization programme in biology may be attached to a minor programme in geology, etc. etc.



FACULTY AND FIELD OF INTEREST (LOYOLA)

McDOUGALL,D.J. Ph.D.	McGill University, 1952 Professor Thermoluminescence of Geological Materials. Radioactive Waste Disposal.
J.T. JENKINS, M.Sc.	McGill University, 1960. Assistant Professor. Crystallography and Igneous Petrology. Crystal morphology and magma conditions. Ultramafic magmatism. Ternary Feldspars.
K.K. MUKHERJI, Ph.D.	Western University, 1968. Associate Professor. Carbonate Petrology and sedimentation of the Northern Appalachian Region.
G.P. SASSANO, Ph.D.	University of Alberta, 1972. Assistant Professor. Uranium Deposits of Northern Sask.

The Geology Departments of Sir George Williams and Loyola are to be merged within the next few years and concentrated on one campus. This will give students the advantage of a wider range of faculty interests and experience.

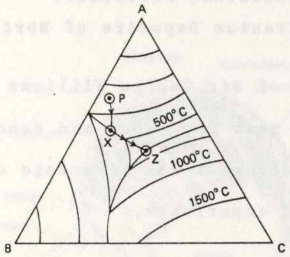


FACULTY AND FIELD OF INTEREST (S.G.W.)

A.N. DELAND, Ph.D., Ph.D. Yale University, 1955.
Associate Professor.
Keewatin Volcanics of the Abitibi Region, Quebec.

H.S. de ROMER, Ph.D., McGill University, 1960.
Associate Professor.
Structures of the Appalachians, Gaspé and Eastern Townships, Quebec.

S. KUMARAPELI, Ph.D., McGill University, 1974.
Associate Professor.
Rift system of the St. Lawrence Valley.



FACILITIES

The Geology Department has excellent classrooms, well-equipped laboratories, adequate library and good collections of minerals, rocks, thin and polished sections, fossils, maps and air-photos. The department has also geophysical equipment, X-ray Diffraction, X-ray Fluorescence and Thermoluminescence. Access to other facilities such as Atomic-absorption and Mass-spectrometer is available from other departments.

FIELD WORK

The Geology Department organizes periodically, during the fall, numerous field trips and excursions to various areas of geological interest in the vicinity of Montreal. Visits to mines, open pits, quarries and road cuts are an essential part of the students' curriculum. In the spring, two field schools of 15 days each are organized to teach students the practical aspects of geophysical exploration and geological survey.

STUDENT PARTICIPATION.

Students in the Geology programme are strongly advised to participate in the projects of the Geology Club which is run exclusively by them. Activities include initiative in choosing guest lecturers, organizing field trips, preparing exhibits and displays for the annual science week and organizing social events which help expand awareness of the discipline,

SCHOLARSHIPS, FINANCIAL AID, AWARDS, MEDALS, AND PRIZES.

Scholarships and prizes are given in recognition of outstanding academic achievements. The medal for geology is awarded annually, when merited, to the graduating student with the highest standing in geology. An annual award is also given by the Canadian Society of Petroleum Geologists to the undergraduate who has demonstrated outstanding competence in fields related to petroleum geology. Financial aid is given to help students solve individual problems. Students are advised to refer to the Office of the Dean of Students.

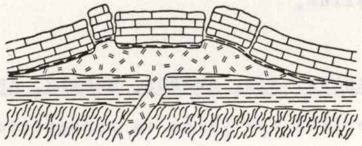
SUMMER EMPLOYMENT

Employment opportunities for well trained students are excellent in Canada. The Department of Geology strongly encourages each student to engage in practical field work during the summer months. This provides financial aid and practical experience which help the student to determine the advantages and disadvantages of a career in geology.

INFORMATION:

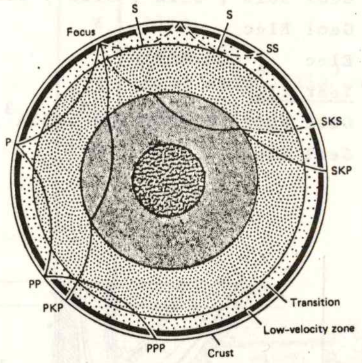
For more detailed information about the Geology Department refer to:

D.J. McDougall, Acting Chairman,
Geology Department,
Loyola Campus,
Montreal, Que.
Tel. 482-0320, ext. 328/491.

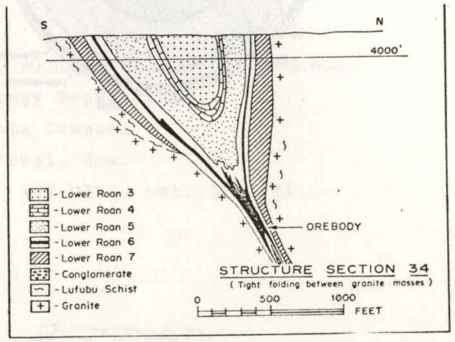


PHILOSOPHY AND OBJECTIVES

Courses are designed to give a good grounding in geological science by providing well balanced programmes which cover all the aspects of the discipline. Particular emphasis is placed on studies which lead to a career in oil, mining and exploration industries. Students are also prepared to enter graduate programs.

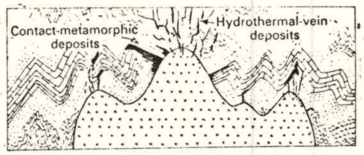


90	BSc Honours in Geology
	Year I
15	Geol 211B^{3}, 222A^{3}, 231B^{3}, 232B^{3}, 241A^{3}
6	Cognate Sc Elec to be chosen from Chem 336Z^{6},342A^{3},344B^{3}, Comp Sc 211B^{3},241^{3}, Math 301A/B^{3}
9	Elec
	Year II
21	Geol 301B^{3}, 311Z^{6}, 312B^{3}, 313B^{3},341B^{3},342B^{3}
3	Geol Elec
6	Elec
	Year III
21	Geol 400Z^{6},411Z^{6},421A^{3},451A^{3},452B^{3}
9	Geol Elec



STRUCTURE SECTION 34
(Tight folding between granite masses)

90	BSc Specialization in Geology
	Year I
15	Geol 211B^{3},222A^{3},231B^{3},232B^{3},241A^{3}
6	Cognate Sc Elec to be chosen from Chem 336Z^{6},342A^{3},344B^{3},Comp Sc 211B^{3},241^{3} Math 301A/B^{3}
9	Elec
	Year II
21	Geol 301B^{3},311Z^{6},312B^{3},313B^{3},341B^{3},342B^{3}
3	Geol Elec
6	Elec
	Year III
15	Geol 411Z^{6},421A^{3},451A^{3},452B^{3}
3	Geol Elec
12	Elec



90	BSc Major in Geology
	Year I
12	Geol 201A^3,203B^3,211B^3,222A^3
18	Elec
	Year II
9	Geol 311Z^6,241A^3
3	Geol Elec
18	Elec
	Year III
12	Geol Elec
18	Elec

24	Minor in Geology
6	Geol 201A^3,203B^3.
18	Geol Elec

NOTE: Geology 205A^3,206B^3,207A^3,211B^3 and 221B^3 may be taken by students in other disciplines who are interested in specific subjects of a geological nature. No previous background in Geology is required.

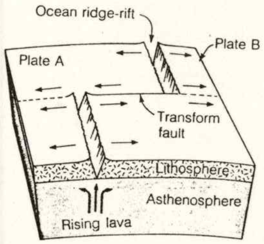
GEOLOGY 201 A

PHYSICAL GEOLOGY

PREREQUISITE: None.

The nature, origin and evolution of the universe, stars and of planetary systems: the physical properties of the Earth and its environment; the materials and structures of the Earth's interior and surface and the processes affecting these regions, such as continental drift, the formation of oceanic basins and mountain building. (3 Credits).

Lectures: 3 hours per week.



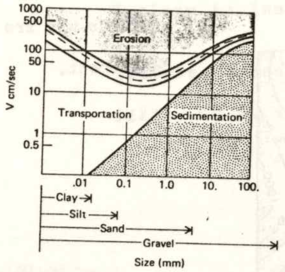
GEOLOGY 202B

ELEMENTARY HISTORY OF THE EARTH.

PREREQUISITE: none.

The hydrologic cycle and the cycle of erosion; the measurement of geologic time; the history of life on earth and the geologic evolution of North America; glaciation and the ice age; the nature and origin of mineral deposits; the geology of coal, oil and gas; the conservation of natural resources. (3 Credits).

Lectures: 3 hours per week.



GEOLOGY 203 Y

INTRODUCTORY LABORATORY COURSE IN GEOLOGY.

PREREQUISITE: None

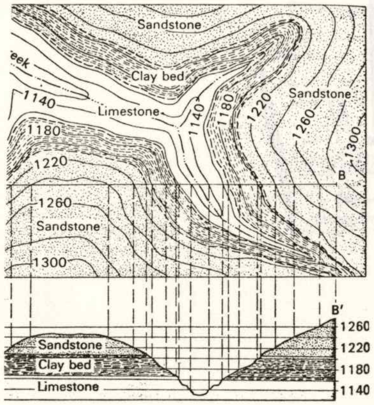
Laboratory studies include investigation of rock and mineral specimens. Interpretation of topographic maps and aerial photographs; interpretation of Geomorphic and Geologic Maps - and the examination of selected fossils. Field trip to local areas.

(3 Credits).

Lab: 3 hours per week.

Text: To be announced.

NOTE: Geology 203Y is primarily designed to provide an introduction to Geology for students who are not majoring in the department.



GEOLOGY 205A

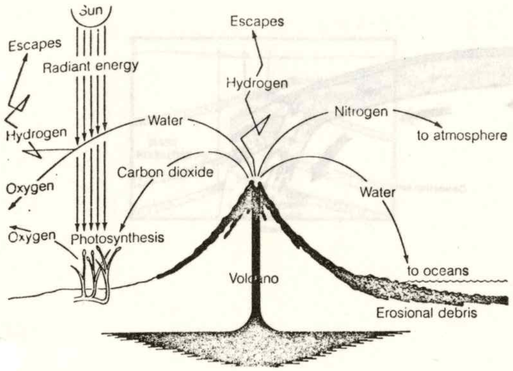
ENVIRONMENTAL GEOLOGY

PREREQUISITE: NONE

Geology in the ecosystem. The earth's atmosphere, hydrosphere, lithosphere and biosphere in the geologic time. Long range geological effects of ecosphere pollution. Trace nutrients and health with emphasis on the geology of trace elements and its cause and effect on biological systems. Understanding of, control for, and prevention of natural hazards. Changes in the earth's climate. Role of Geology in land use. (3 Credits)

Lecture: 3 hours per week.

TEXT: To be announced.



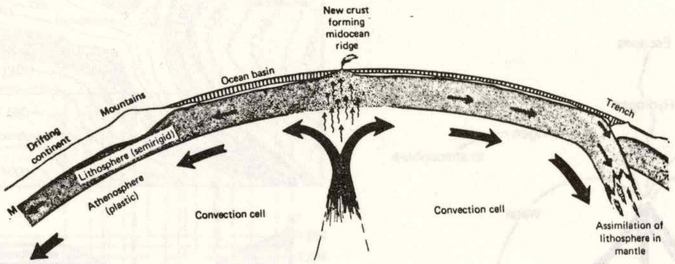
GEOLOGY 206 K
CONTINENTAL DRIFT
PREREQUISITE: NONE

An introduction for non majors to the concept of Continental Drift. The origin and development of the theory, the nature of the earth's crust, the ocean floor, and the theory of sea floor spreading. The revolution in the Earth Sciences as a result of widespread acceptance of the concept.

(3 Credits).

Lecture: 3 hours per week.

Text: Wilson, ed: Continental Adrift, Freeman.



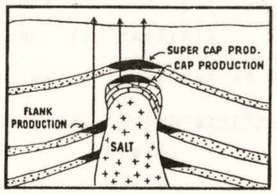
GEOLOGY 207 A
GEOLOGY OF RESOURCES
PREREQUISITE: NONE

Rocks and Ore minerals. Present and future availability of earth resources The nature, classification and mode of occurrence of mineral deposits. Exploration, development and rational exploitation of mineral resources. Elements of mining economics. Distribucion of oil, gas, coal, and base metal deposits. Evaluation of the effects of mining operations on environment.

(3 Credits).

Lecture: 3 hours per week.

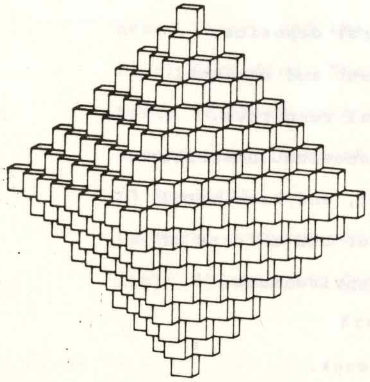
Text: To be announced.



GEOLOGY 211B

MINERALOGY

PREREQUISITE: None



Physical and chemical properties of minerals, elements of crystal chemistry, mineral classification, silicate structure and a description of important silicate mineral groups are topics covered in lectures. In the lab, the composition, diagnostic properties and geological environments of some 150 minerals (non-silicates and silicates) are emphasized and physical and simple chemical tests are applied to the identification of these minerals. (3 Credits).

Lectures: 1 1/2 hours per week.

Lab: 1 1/2 hours per week.

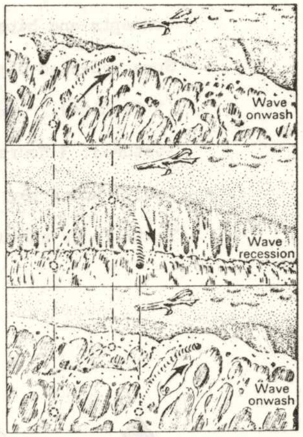
Text: Hurlbut, Dana's Manual of Mineralogy, 18th Ed. (Wiley).

GEOLOGY 221B

PHYSICAL OCEANOGRAPHY

PREREQUISITE: NONE

Geomorphology of the ocean floor with emphasis on the significance of the mid-oceanic ridges and trench systems. The physical and chemical characteristics and circulation of ocean waters and their causes. Tides and waves. Distribution and origin of terrigenous, biogenous, chemogenic, volcanogenic and polygenic sediments in the major ocean basins. Conditions of oceanic sedimentation. Quantitative distribution of suspended sedimentary materials at the ocean surface, at depth, and over the ocean bottom. Size composition of suspensions and bottom sediments. Economic resource potential of the oceans. (3 Credits).



Lectures: 3 hours per week

Text: Gross. Oceanography, Prentice Hall.

GEOLOGY 222 A

INVERTEBRATE PALEONTOLOGY

PREREQUISITE : Geol . 201 A

A systematic survey of major invertebrate fossil groups with chief emphasis on morphology, classification, and geologic occurrence. Study of principles of evolutionary concepts and biostratigraphic zonation. Some selected discussion on paleoecology. (3 Credits).

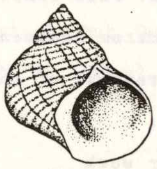
Lectures: 3 hours per week

Lab: 3 hours per week

Text: To be announced.

Trochiform

Pupiform


Turbinate

GEOLOGY 231B

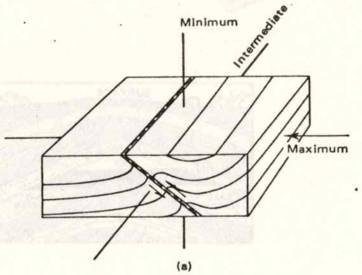
EARTH PHYSICS Half Course

PREREQUISITE : Geol. 201 A

This course is directed towards the general understanding of physical phenomena of the solid earth. Subjects for consideration include the following: earth's origin, age, radio activity, magnetism, gravity field, seismology, heat flow, structure and physical state of the earth's interior, theory of sea-floor spreading, theories of mountain formation. (3 Credits)

Lectures: 3 hours per week.

Lab: 3 hours per week.
Text: To be announced.

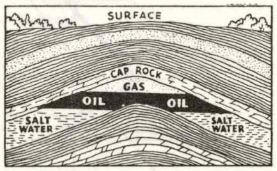


GEOLOGY 232 B
EXPLORATION GEOLOGY
PREREQUISITE : Geol . 231B

Surveying, surface and sub surface mapping methods, property evaluation and development, Mining operation and cycles, Soil geochemistry,data storage and retrieval.

The second part of the course will include actual field survey using seismic, magnetic, gravity and electrical techniques. Students will be required to pay for room and board for a one-week period in the field school.

Field Work: 2 weeks in May at the Concordia Geophysics Field School.



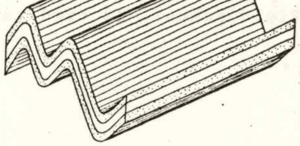
GEOLOGY 241 A
STRUCTURAL GEOLOGY
PREREQUISITE: Geol. 201 A

The recognition and origin of geologic structures. Primary structures, faults, folds and joints, principles of rock deformation. Laboratory includes a survey of methods of structural interpretation, structural experiments and field trips.

(3 Credits)

Lectures: 3 hours per week

Lab: 3 hours per week



GEOLOGY 301B

FIELD GEOLOGY

PREREQUISITE: Geology 241A and 311Z.

Surface and underground field mapping methods. Preparation of geological maps, sections and reports from field notes, diagrams and air photos. Special field trips to examine specific geologic problems. Students will be required to pay for room & board for a ten-day period. Field Work: 2 weeks in May at the Concordia Geology Field School. (3 credits).

GEOLOGY 302 B

GEOSTATISTICS AND COMPUTER APPLICATION IN GEOLOGY

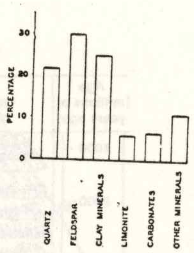
PREREQUISITE: GEOL. 201 A

Statistical analysis and Computing methods applied to geological problems. (3 Credits).

Lectures: 3 hours per week

Lab: 3 hours per week.

Text: To be announced.



GEOLOGY 303B

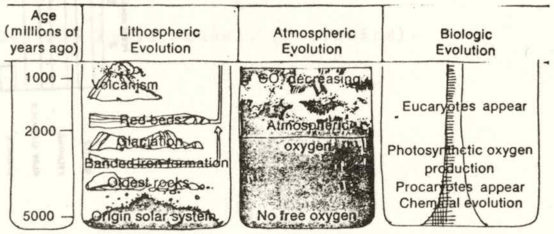
PRECAMBRIAN GEOLOGY

PREREQUISITE: Geol. 342 B

Evolution of the earth in the Precambrian era. Problems in Precambrian correlation, paleoclimates and structural history. Emphasis on Canadian and North American Precambrian areas. One term paper to be prepared. (3 Credits)

Lectures: 3 hours per week

Periodic Seminars



GEOLOGY 311Z

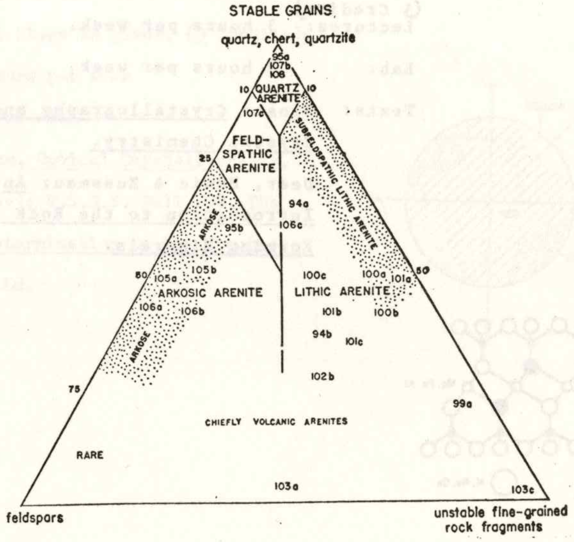
ELEMENTARY PETROLOGY

PREREQUISITE : Geol. 211 A

The identification and description of hand specimens of sedimentary, igneous and metamorphic rocks. Methods of classifying rocks. (6 Credits).

Lectures: 3 hours per week

Lab: 3 hours per week



GEOLOGY 312 A Mineralogy II

Half Course

PEREQUISITE : Geol. 211 A

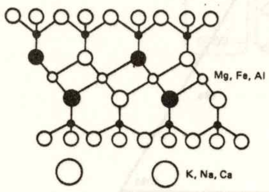
Point and translational symmetry, point groups, space groups, interpretation of Space Group tables, elements of crystal chemistry, chemistry and phase relations of important rock forming minerals. Stereographic projections of crystal data, the Universal Stage and powder diffractometry in identifying minerals are subjects stressed in Labs. (3 Credits)

Lectures: 3 hours per week.

Lab: 3 hours per week.

Texts: Bloss: Crystallography and Crystal Chemistry.

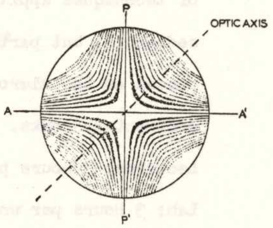
Deer, Howie & Zussman: An Introduction to the Rock Forming Minerals.



GEOLOGY 313 B
OPTICAL MINERALOGY

PREREQUISITE: Geol. 211 A

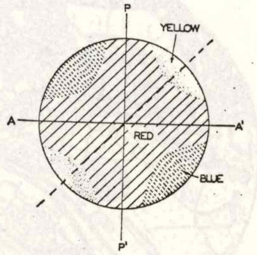
Lectures deal with the theoretical background necessary for the use of the petrographic microscope. In the laboratory, oil immersion techniques for the determination of isotropic and anisotropic minerals in powder form are studied. If time permits, an introduction to the use of the four-axis Universal Stage is given. (3 Credits).



Lectures: 3 hours per week

Lab: 3 hours per week

Text: Wahlstrom, Optical Crystallography, 3rd Ed., (Wiley); U.S.G.S. Bull 848, The Microscopic Determination of the Nonopaque Minerals, 2nd Ed.



GEOLOGY 314B

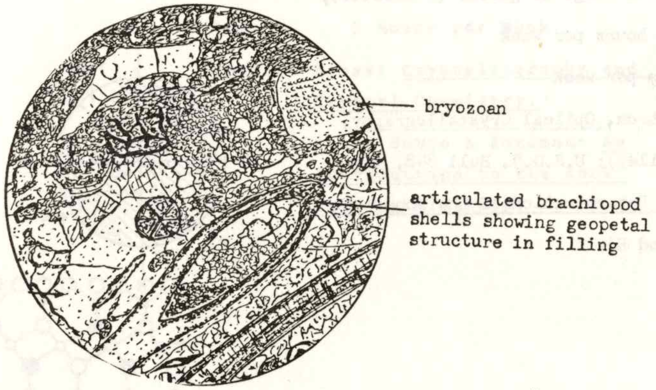
SEDIMENTARY PETROLOGY

PREREQUISITE : Geol. 311Z, 313B

The occurrence and formation of sedimentary rocks. Laboratory includes a brief survey of techniques applied to unconsolidated sediments, but particular emphasis is placed on the microscopic examination of sedimentary rocks. (3 Credits).

Lectures: 3 hours per week

Lab: 3 hours per week


bryozoan
articulated brachiopod shells showing geopetal structure in filling

GEOLOGY 315A

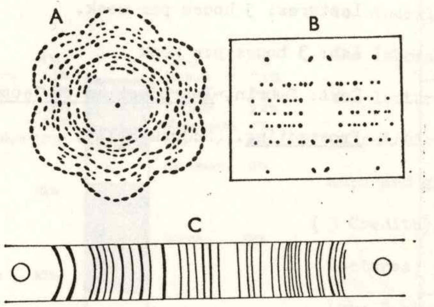
INTRODUCTION TO X-RAY CRYSTALLOGRAPHY

PREREQUISITE : Geol. 211 A , 312 A

The nature of X-rays, diffraction, the reciprocal lattice, powder diffractometer, powder cameras, single crystal methods. Laboratory work will stress the techniques of powder diffractometry and Precession photography. (3 Credits)

Lectures: 2 hours per week

Lab: 4 hours per week



A, Laue diagram of a hexagonal mineral, beryl; B, rotation diagram of an orthorhombic mineral; C, powder diagram of quartz.

GEOLOGY 331 B

EXPLORATION GEOPHYSICS

PREREQUISITE : Geol. 231

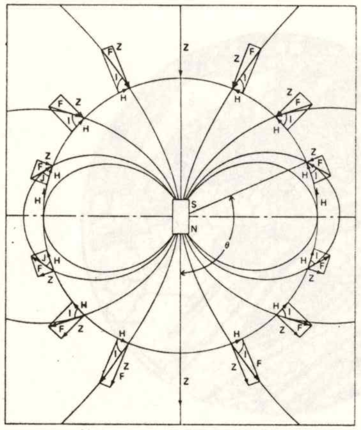
An introduction to geophysical methods of prospecting and of investigating subsurface structures. The theories, uses and limitations of various magnetic, electrical gravitational and seismic methods are explained and compared. The practical operation of the instruments is reviewed and actual field results are analyzed.

(3 Credits)

Lectures: 3 hours per week.

Lab: 3 hours per week

Text: Dobrin, Introduction to Geophysical Prospecting. (McGraw-Hill).



GEOLOGY 332B

GEOCHEMISTRY.

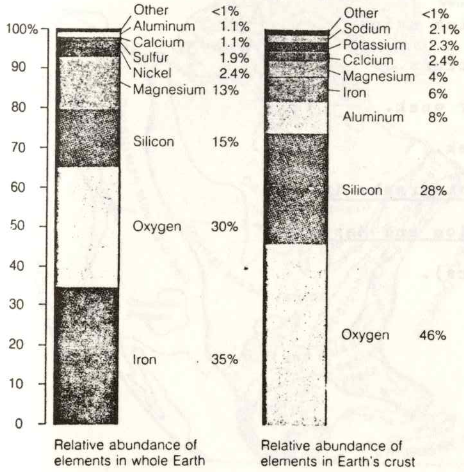
PREREQUISITE: Geol. 201A, 211A.

An introduction to geochemistry including the chemical make-up of the solar system and the geochemistry of the atmosphere, hydrosphere, crust, mantle and core. The chemistry of igneous, sedimentary and metamorphic rocks, with some emphasis on the trace elements which characterize each. Anomalous trace element concentrations in rocks, soils and water and the application to mineral exploration geochemistry. In the laboratory the material discussed in the lectures is illustrated by geochemical calculations, trace element distribution maps and methods of geochemical analysis.

(3 Credits).

Lectures: 3 hours per week

Lab: 3 hours per week



Relative abundance of elements in whole Earth

Relative abundance of elements in Earth's crust

GEOLOGY 341B
PHOTOGEOLOGY

PREREQUISITE: Geology 241A or permission of the Department. Scope and purpose of photo-interpretation geometry of aerial photographs and basic applied photogrammetry; geological interpretation, both qualitative and quantitative, of aerial photographs from Canada and other countries; techniques used in base map preparation with and without control points; exercises in photogeological mapping using stereoscopes and plotters.

Lectures: 3 hours per week.

Lab.: 3 hours per week.

Text: Ray, Aerial Photographs in Geologic Interpretation and Mapping (U.S.G.S.). (3 credits).

GEOLOGY 342 B
TECTONICS
PREREQUISITE: Geol. 241 A

Relation of deformation to intrusion and sedimentation. Consideration is also given to multiple deformation, structural petrology, theories of geosynclines and plate tectonics. Laboratory: Consists of tectonic analysis using geologic maps.

(3 Credits)

Lectures: 3 hours per week

Lab: 3 hours per week

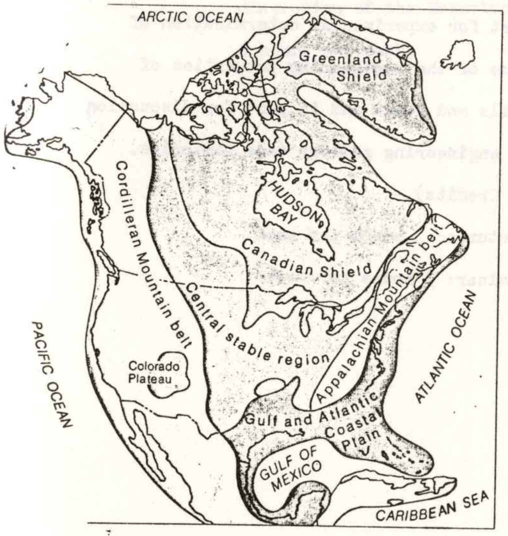
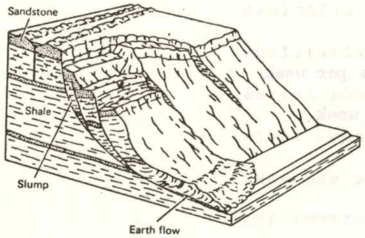


Figure 22-50
Major tectonic features of North America.

GEOLOGY 351 A

ENGINEERING GEOLOGY

PREREQUISITE: GEOL. 201 A,241 A



Engineering properties of rocks and soils. Ground water. Frost action and permanently frozen ground. Stream flow, erosion and deposition. Application of geology to engineering problems - tunnels, slope control, foundations, roads and airports, dams and reservoirs, river and shoreline control. Elements of rock and soil mechanics. The laboratory will be utilized in part for experimental determination of some of the engineering properties of soils and rocks and in part for discussion of engineering geology case histories. (3 Credits).

Lectures: 3 hours per week

Seminar: 3 hours per week

GEOLOGY 400 Z

UNDERGRADUATE THESIS

Honours students in their final year are expected to show competence in isolating and examining a geological problem using techniques available within the department, working in conjunction with assigned faculty advisers. Course evaluation will be based on the student's performance in the investigation and on the written report. Specialized students may also take the course at the discretion of the Department. (6 Credits) 6 hours per week.

GEOLOGY 411 Z

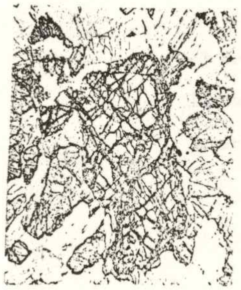
IGNEOUS AND METAMORPHIC PETROLOGY

PREREQUISITE: Geol. 311 Z, 313.

Presentation and interpretation of phase relations, mineralogy, fabric, classifications and petrogenesis of the igneous rocks. The scope of metamorphism, the zone, grade and facies concepts of metamorphism, ACF and AKF diagrams. In the laboratory, megascopic and microscopic techniques are used in the examination of rocks representative of the more common igneous and metamorphic varieties. (6 Credits)

Lectures: 3 hours per week

Lab: 3 hours per week



GEOLOGY 412 A

MINERAL PHYSICS

PREREQUISITE: GEOL. 211 A, 312 A, 311 Z
332 B

Selected aspects of the relationship of solid state characteristics of minerals to their conditions of formation and subsequent history. In the laboratory details of crystal structure are considered and readily developed changes in solid-state conditions in minerals and metals are used to amplify the lecture material. (3 Credits).

Lectures: 2 hours per week

Lab: 4 hours per week

Texts: Deer, Howie and Zussman, An Introduction to the Rock Forming Minerals (Longmans); Spry, Metamorphic Textures: (Pergamon). References: Van Vlack, Elements of Materials Science, 2nd Ed., (Addison-Wesley); and/or Wulf et al, The Structure and Properties of Materials, (Wiley).

GEOLOGY 421A

STRATIGRAPHY

PREREQUISITE: Geology 201A and 222A.

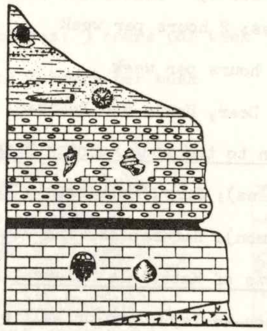
A thorough analysis of various stratigraphic principles will be made using examples from Canadian and American type stratigraphic models.

Lectures: 3 hours per week.

Lab. 3 hours per week.

Text: R.K. Matthews, Dynamic Stratigraphy, Prentice Hall.

(3 credits).



GEOLOGY 451 A

ECONOMIC GEOLOGY

PREREQUISITE: GEOL. 201 A, 241 A

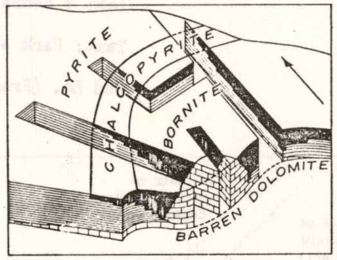
The origin, classification and evaluation of ore and petroleum deposits. Laboratory includes problems in ore evaluation and petroleum geology, and the examination of suites from representative mining camps.

(3 Credits).

Lectures: 3 hours per week

Lab: 3 hours per week

Text: To be announced



GEOLOGY 452 B

MINERAL DEPOSITS

PREREQUISITE: GEOL. 313 , 311 Z , 451 A

The origins, type of occurrence and classification of metallic mineral and non-metallic mineral deposits. The application of all fields of geology to a specific problem. Laboratory includes exercises on property and ore evaluation, an introduction to incident light microscopy and a series of examinations and a term project on suites from various ore deposits.

(6 Credits)

Lectures: 3 hours per week

Lab: 3 hours per week

Text: Park and MacDiarmid, Ore Deposits, 2nd Ed. (Freeman).